CLAIMS

What is claimed is:

Sub A1

1. A method for reducing pilot tone phase interference at the transmitter in a discrete multi-tone (DMT) communications system comprising:

generating DMT signal segments REVERB and SEGUE with a pseudo-random pattern generator using an initial pattern that minimizes the pilot tone phase offsets in both segments; and

transmitting the above-defined REVERB and SEGUE signals in the DMT initialization sequence.

2. The method of claim 1, further comprising:

generating ADSL-over-POTS DMT signal segments C-REVERB and C-SEGUE with a pseudo-random pattern generator polynomial as defined by the ADSL standard but using an initial pattern of 90 (0x05A); and

transmitting the C-REVERB and C-SEGUE signal in the DMT ADSL standard initialization sequence.

3. A method for timing recovery at the receiver in a discrete multi-tone (DMT) communications system comprising:

receiving a plurality of signals generated and transmitted by an associated far-end transmission unit;

converting the plurality of received signals through an analog to digital converter (ADC);

detecting a phase error on the received pilot tone;

applying the phase error to a phase locked-loop to generate a frequency correction signal; and

using the frequency correction signal to modify the sampling time of the ADC.

4. The method of claim 3, wherein the detection of phase error is compensated by an offset based on the received signal segment in the initialization sequence.

5. The method of claim 3, wherein the step of detecting a phase error is performed with a state machine in communication with the ADC output and the input to the phase locked-loop.

6. The method of claim 3, further comprising:

synchronizing a digital to analog converter (DAC) in the transmitting path by using a sampling clock derived from the phase locked-loop controlled ADC.

7. A method for timing recovery at the receiver in a discrete multi-tone (DMT) communications system comprising:

receiving a pilot tone generated and transmitted by an associated far-end transmission unit along with other signal streams at a particular receiver;

converting the plurality of received signals through an analog to digital converter (ADC) to create a digital signal stream;

detecting the cyclic prefix in the received digital signal stream;

zeroing out the received digital signal stream from the input to a phase locked-loop while the cyclic prefix is present in the received signal stream to create a frequency correction signal; and

using the frequency correction signal to modify the ADC sampling timing.

8. The method of claim 7, further comprising:

synchronizing a digital to analog converter (DAC) in the transmitting path by using a sampling clock derived from the phase locked-loop controlled ADC.

9. A method for timing recovery at the receiver in a discrete multi-tone (DMT) communications system comprising:

receiving a standard pilot tone generated and transmitted by an associated far-end transmission unit along with other signal streams at a particular receiver;

converting the plurality of received signals through an analog to digital converter (ADC) to create a digital signal stream;

detecting the cyclic prefix in the received signal stream;

performing a time-domain equalization on the received signal stream;

removing the cyclic prefix portion of the equalized digital signal stream from the input to a phase locked-loop to create a frequency correction signal; and

using the frequency correction signal to modify the sampling time of the ADC.

10. The method of claim 9, further comprising:

synchronizing a digital to analog converter (DAC) in the transmitting path by using a sampling clock derived from the phase locked-loop controlled ADC.

11. A method for timing recovery at the receiver in a discrete multi-tone (DMT) communications system comprising:

receiving a standard pilot tone generated and transmitted by an associated far-end transmission unit along with other signal streams at a particular receiver;

converting the plurality of received signals through an analog to digital converter (ADC) to create a digital signal stream;

detecting the cyclic prefix in the received signal stream;

using the equalized signal stream with the cyclic prefix portion removed to estimate the phase error with a discrete Fourier transform (DFT);

applying the estimated phase error to the input of a phase locked-loop to create a frequency correction signal; and

using the frequency correction signal to modify the sampling time of the ADC.

12. The method of claim 11, further comprising:

synchronizing a digital to analog converter (DAC) in the transmitting path by using a sampling clock derived from the phase locked-loop controlled ADC.

13. A digital signal processor configured to apply the method of claim 1.

14. A digital signal processor configured to compensate for the offset in phase error on a received pilot tone based upon the received signal segment in the discrete multi-tone (DMT) system initialization sequence.

15. The digital signal processor of claim 14, wherein the phase error compensation is accomplished with a state machine.

16. A digital signal processor configured to detect and zero out the cyclic prefix from a received digital signal stream when the cyclic prefix is present to create an input to a phase locked-loop.

17. The digital signal processor of claim 16, wherein the digital signal processor is configured to perform a time-domain equalization on a received digital data stream and to create an input to a phase locked-loop when the cyclic prefix is zeroed out from the signal stream.

18. A digital signal processor configured to detect and remove the cyclic prefix from a received digital signal stream when the cyclic prefix is present, the digital signal processor further configured to first perform a time-domain equalization of the digital signal stream, then to perform a discrete Fourier transform on the digital signal stream when the cyclic prefix is not present to create a phase error signal for application at the input to a phase locked-loop.

19. A system for timing recovery in a discrete multi-tone communications system comprising:

an analog to digital converter (ADC);

a state machine in communication with the ADC configured to determine the phase offset on a pilot tone in a received signal segment; and

a phase locked-loop in communication with the state machine configured to compensate for the phase offset and to apply a control signal to the ADC, wherein the received signal samples are synchronized for further processing at a rate compatible with that of a source transmission.

20. The system of claim 19, further comprising:

a sampling clock in communication with the analog to digital converter, the sampling clock in further communication with a digital to analog converter (DAC) in an upstream data path for synchronizing data transmitted in an upstream direction to the source.

21. A system for timing recovery in a discrete multi-tone communications system comprising:

an analog to digital converter (ADC) configured to create a digital representation of the received signal;

a phase locked-loop in communication with the ADC configured to receive the received signal and to apply a control signal to the ADC, wherein the received signal sample stream is synchronized for further processing at a rate compatible with that of a source transmission; and

a symbol synchronizer in communication with the ADC configured to determine when the data stream contains a cyclic prefix, the symbol synchronizer further configured to remove the received signal from the phase locked-loop input when the cyclic prefix is present.

22. The system of claim 21, further comprising:

a sampling clock in communication with the analog to digital converter, the sampling clock in further communication with a digital to analog converter (DAC) in the transmitting path for synchronizing data transmitted in the reverse direction to the far-end transmission unit.

23. A system for timing recovery in a discrete multi-tone communications system comprising:

an analog to digital converter (ADC) configured to create a digital representation of the received signal;

an equalizer in communication with the ADC, the equalizer configured to perform a time-domain equalization on the received signal;

a phase locked-loop in communication with the ADC and the equalizer configured to receive the received signal and to apply a control signal to the ADC, wherein the received signal sample stream is synchronized for further processing at a rate compatible with that of a source transmission; and

a symbol synchronizer in communication with the ADC configured to determine when the signal stream contains a cyclic prefix, the symbol synchronizer further configured to remove the time-domain equalized signal from the phase locked-loop input when the cyclic prefix is present.

24. The system of claim 23, further comprising:

a sampling clock in communication with the analog to digital converter , the sampling clock in further communication with a digital to analog converter (DAC) in the transmitting path for synchronizing signal transmitted in the reverse direction to the far-end transmission unit.

25. A system for timing recovery in a discrete multi-tone communications system comprising:

an analog to digital converter (ADC) configured to create a digital representation of the received signal;

an equalizer in communication with the ADC, the equalizer configured to perform a time-domain equalization on the received signal;

a discrete Fourier transform (DFT) in communication with the equalizer, the DFT configured to convert the time-equalized received signal and to generate a pilot tone phase error estimate signal;

a symbol synchronizer in communication with the ADC configured to remove the cyclic prefix from the signal sample stream; and

a phase locked-loop in communication with the ADC and the DFT configured to receive the pilot tone phase error estimate and to apply a control signal to the ADC, wherein the received signal sample stream is synchronized for further processing at a rate compatible with that of a source transmission.

26. The system of claim 25, further comprising:

a sampling clock in communication with the analog to digital converter , the sampling clock in further communication with a digital to analog converter (DAC) in the transmitting path for synchronizing signal transmitted in the reverse direction to the far-end transmission unit.

27. A system for timing recovery at the receiver in a discrete multi-tone (DMT) communications system comprising:

means for receiving a pilot tone generated and transmitted by an associated far-end transmission unit;

means for converting the received pilot tone along with the other received signals from an analog to a digital signal;

means for detecting a phase error on the received pilot tone;

means for applying the phase error to a phase locked-loop to generate an output signal responsive to when the cyclic prefix is not present in the digital signal; and

means for using the output signal to modify the analog to digital conversion timing.

28. A method for timing recovery at the receiver in a discrete multi-tone (DMT) communications system comprising:

means for receiving a standard pilot tone and far-end signal from an associated far-end transmission;

means for converting the plurality of received signals from analog to digital signals;

means for detecting the cyclic prefix in the received far-end signal;

means for removing the cyclic prefix in the received far-end signal;

means for estimating the phase error in the pilot tone with a discrete Fourier transform (DFT);

means for applying the estimated phase error to the input of a phase locked-loop to create a frequency correction signal; and

means for using the frequency correction signal to modify the sampling rate of the analog to digital conversion.

29. A method for timing recovery at the receiver in a discrete multi-tone (DMT) communications system comprising:

means for receiving a standard pilot tone along with a plurality of signals at this particular receiver from a far-end signal;

means for converting the plurality of signals from analog to digital signals;

means for performing a time-domain equalization on the far-end signal;

means for detecting the cyclic prefix in the far-end signal;

means for zeroing out the equalized digital signal from the input to a phase locked-loop while the cyclic prefix is present in the received signal to create frequency correction signal; and

means for using the frequency correction signal to modify the sampling rate of the analog to digital conversion.

30. A method for timing recovery at the receiver in a discrete multi-tone (DMT) communications system comprising:

means for receiving a far-end signal along with a plurality of signals at the receiver;

means for converting the plurality of received signals from an analog to a digital format;

means for detecting the cyclic prefix in the far-end signal;

means for zeroing out the far-end signal when the cyclic prefix is present from the input to a phase locked-loop; and

means for using the phase locked-loop output to modify the sampling rate of the analog to digital conversion.

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